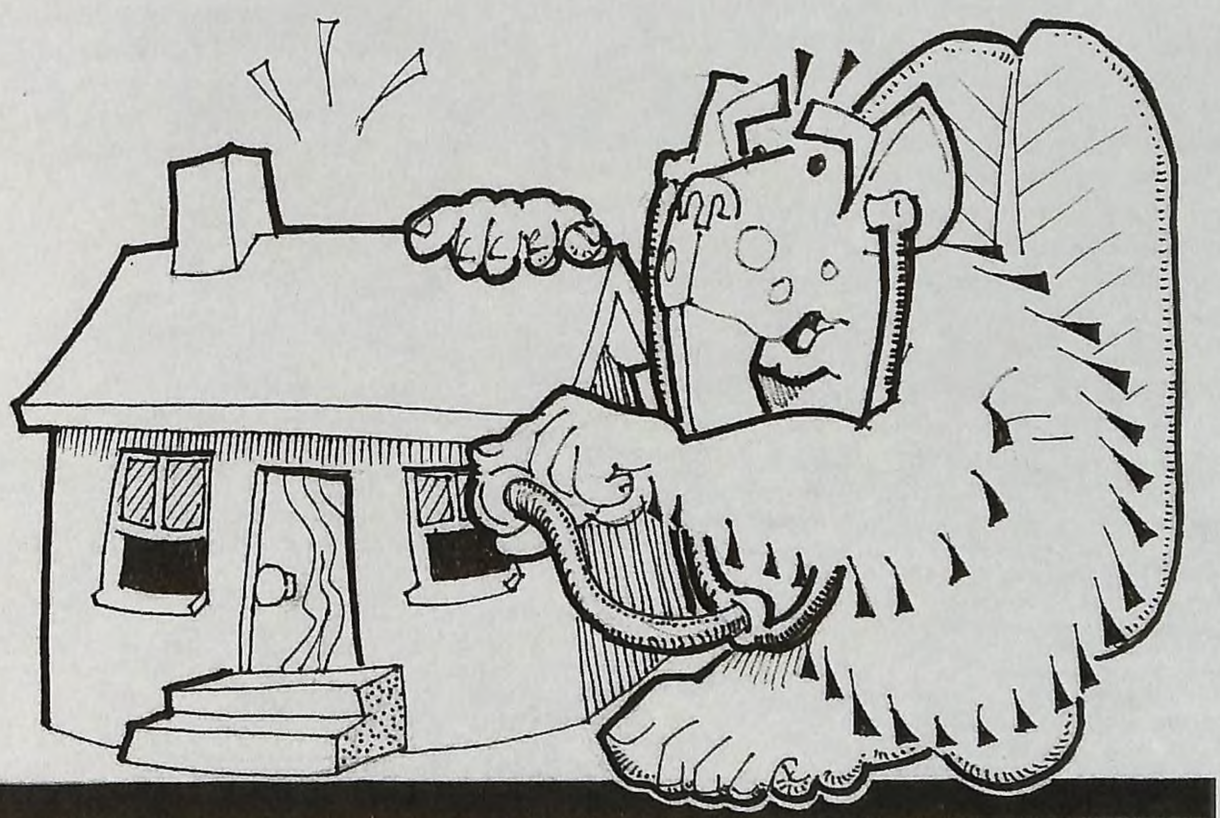
No. 119 November 2004

solplan review

the independent journal of energy conservation, building science & construction practice

Inside

Healthy Homes



From the Editor . . .

Recently, I have had the opportunity to do a considerable amount of travel, not just within Canada, but also overseas to China. It was not a holiday jaunt, but rather a working trip to support Canadian housing exporters.

We have grown up with mixed images of China. The image we have will depend on when we first heard about the country and in what context. From school, the image may be that of a giant somewhat inward-looking country with an ancient civilization. For many of us it may be the political and historical images of the Cold War, which gave us an image of a drab, underdeveloped, overpopulated country oppressed by communist party apparatchiks. For others, it may be the country of poorly paid semi-slave labour churning out all manner of cheap, low-quality products that in the past were done by well-qualified workers in more developed countries.

There may be an element of truth in these images, but they are fast fading. The industrial development is real. Major cities have an appearance of modern cities anywhere. Low tech they are not. Not only are we using cheap household products and wearing clothes made in China, we already are also working with a range of high-tech products and tools that have been manufactured there.

The tremendous growth in China is having an impact on the access to and availability of many materials in Canada. The sudden steep rise in the price of steel is not just the result of the American war machine's needs, but the demand of the Chinese market for construction materials. In Shanghai itself, development is frenetic. A whole section of the city with a tower only a few metres shorter than Toronto's CN Tower, and literally dozens of high rise office and residential towers have literally mushroomed out of underdeveloped fields within the last ten years.

By comparison, the Yaletown development on the former Expo lands in Vancouver over the past fifteen years is merely a small, insignificant neighbourhood.

Those of us in Vancouver or Toronto who whine about traffic gridlock should check out Shanghai (a city of only about 16 million). There, despite a network of elevated roads running throughout the city moving traffic is a wonder to behold. Those who advocate more freeways to solve urban traffic take note. In Shanghai, you can talk to residents on fifth floor apartments while you're stuck in traffic on the freeways that crisscross the city.

The frenetic development and industrialization, as well as the growth in the automobile population, means that the rise in oil prices is not just an American war issue, but also due to the increased demand of the Chinese domestic market for oil.

And for those in Vancouver or Toronto who worry about smog should only consider the nearly constant brown pea soup that hangs over Shanghai and other Chinese cities.

The mainstream media has been full of reports recently about China. What is happening in China today will increasingly have an impact on the rest of the world. There are lessons for all of us if we want to preserve the quality of the environment. We need to clean up our act at home, and assist China and the other developing countries in cleaning up their environment by leapfrogging old technology and moving to new, clean, energy-efficient and environmentally appropriate systems. After all, those smog clouds they generate contain all manner of contaminants that are moving one way–and that is eastward across the Pacific. Particulate matter from Asia has already been observed on the west coast of North America.

Richard Kadulski,
Editor

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the independent journal of energy conservation, building science & construction practice

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ISSN: 0828-6574
Date of Issue: December 2004
SOLPLAN REVIEW is published 6 times per year by:
the drawing-room graphic services ltd.
PO Box 86627, North Vancouver, BC V7L 4L2
Tel: 604-689-1841 Fax: 604-689-1841
e-mail: solplan@direct.ca
Street address:
#204 - 1037 West Broadway
Vancouver, BC V6H 1E3

Publications Mail Agreement No. 40013363
Postage paid in Vancouver, BC.
Return undeliverable Canadian addresses to
PO Box 86627, North Vancouver, BC V7L 4L2

SUBSCRIPTIONS: In Canada 1 year $50.29 (incl GST) (NB, NS, NF $54.05 includes HST); 2 years $90.95 (incl GST) (NB, NS, NF $97.75 includes HST). USA and other foreign payable in US $ 1 year $54.00, 2 years $98.00.

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PRINTED IN CANADA
GST Registration: R105208805

Are There Customers for Healthy Homes?

Concerns about the home environment have increased because we now spend more than 90% of our time indoors, the majority of it at home. Homes today can be designed and operated in a more healthy and sustainable way.

In Canada, healthy housing programs were initiated in the early 1980s by CMHC with efforts being mainly directed at energy conservation. CMHC identified the key elements of a healthy house as:

- occupant health
- energy efficiency
- resource efficiency
- environmental responsibility
- affordability

The "healthy house" concept was also popularized in the late 1980s by several publications. ***The Healthy House: How to Buy One, How to Build One, How to Cure a Sick One by Bower*** (1989) and ***The Healthy Home*** (1989) by Linda Hunter were among the first commercial publications dealing with the indoor home environment, especially air quality.

In the early 1990s, issues such as the selection of environmentally-friendly building materials, indoor air quality, water and waste reduction, recycling, and the elimination of chlorofluorocarbon gases, began to attract attention

As in other parts of the world, the preoccupation with the quality of the indoor environment in Canada began as a result of the evolution of more precise measurement techniques, advances in medical technologies, and the increasing number of respiratory related illnesses like asthma.

From the energy crisis of the 1970s on, new energy-efficient, tighter, and better-insulated houses were built to save fuel for heat. One of the consequences was that the quality of the indoor environment in houses and the health of their occupants became compromised if they were not built properly, fully recognizing that the house is a system.

Since its inception, the R-2000 Program has recognized the importance of treating the whole house-as-a-system and has incorporated mechanical ventilation to ensure continuous air change. However, this point was missed by many who air-sealed the house and upgraded insulation but did not install effective ventilation. As a result, the air quality in many airtight homes was compromised.

Inadequate indoor air quality has been identified as one of the major causes and contributing factors to the increasing occurrence of asthma, which is estimated to cost Canadians nearly $600 million per year in direct expenses for medication, nursing, and medical care.

There has been a great deal of movement towards more healthy housing design and construction. The number of 'ecofriendly' substitutes for traditional materials is increasing and educational programs have recently been directed at designers and builders. But there is still an information gap that is hindering the growth of the healthy home concept: an understanding of consumers' attitudes and desires.

Owners and occupants, the consumers of building products and services, are the ones who benefit from healthier homes and can create market pull for housing characteristics that meet their needs and wants. However, it is builders, designers and developers that usually make decisions, often based on their understanding of costs, qualitative aspects or purchasers' wishes. Often there may be small incremental cost premiums to be paid up front, adding to capital cost, although these offer benefits to the user in the form of lower operating costs and superior indoor environmental quality.

The challenge for builders and designers is to understand consumer attitudes. If you understand what people are prepared to do and buy, it will help you to develop strategies for presenting alternatives.

A resent research study at the University of BC set out to examine the healthy house concept in the Canadian housing market. The project focussed on identifying what Canadian householders value and want in the indoor environment of their homes. The study focussed on occupant health and comfort, as well as their

R-2000

For information on the R-2000 Program, contact your local program office, or call 1-800-387-2000 www.R-2000.ca

willingness to pay for better indoor air quality, lighting, and acoustics in their home environments, along with their preferences for various healthful living attributes.

Researchers surveyed more than 3,500 households across the country to determine which were the most important healthy home attributes, and if there was a willingness to pay for better indoor environmental quality.

The first interesting observation made was that knowledge of the "healthy home" concept is positively related to a willingness to pay for better indoor air quality, lighting and acoustics. When people become more aware of a product, service, or concept there is a greater chance they will be willing to pay more for it. This indicates that an educational approach with respect to indoor environmental quality may be the first step in the development of a successful promotional campaign.

Consumer demand for better features was also related to factors such as income and the level of satisfaction with and the level of importance given to each particular indoor environmental quality feature. Not surprisingly, the less satisfied a householder was with their current situation the more likely they were to pay more for better quality.

Similarly, the more importance householders place on indoor air quality, lighting, and acoustics, the more likely they are to pay a higher premium for them.

Income had a relationship to willingness to pay. Householders with higher incomes were more likely to pay more for better indoor environmental quality features. Age was not related to willingness to pay more for better acoustics, but had a negative relationship to indoor air quality and lighting. Older people were less likely to pay extra for either of these two features. In related fields such as ecology and green marketing, seniors were generally found to be less sensitive to environmental issues.

Women showed less interest in paying more for better indoor air quality than men, while people who were more involved in indoor activities were more likely to pay more for both better indoor air quality and better lighting

Products and materials promoting energy efficiency, natural light, better insulation, and non-allergenic qualities, may be well positioned when targetting Canadian households.

In Canada, we find ourselves at an important juncture as far as the idea of healthful living is concerned. This study shows that there are potential market opportunities for the "healthy home" concept.

The housing industry needs to become aware that there is a demand for healthy homes. At the same time, consumers need to be informed about healthy homes and the systems and products required to create them.

Willingness to Pay and Preferences for Healthy Home Attributes in Canada *by Wellington Spetic, Robert Kozak, David Cohen, Faculty of Forestry, University of British Columbia*

Plastics Linked to Allergies in Kids

The medical community has noticed an increase in the number of people with asthma and allergies. A recent scientific study in Sweden has found that exposure to phthalates – compounds used in making plastics – at levels commonly found indoors, can be associated with allergic symptoms in children. The findings come from a study of 400 Swedish children. About half had persistent allergic symptoms and half did not. The researchers evaluated each child as well as their home environment.

Samples of house dust from allergic subjects had higher levels of butyl benzyl phthalate (BBzP) than those from non-allergic participants. Phthalates are all around us in a host of plastic products. This study suggests that they may be having a direct influence on the health of a great number of children.

Although many factors are likely responsible for the increases in allergies and asthma that have been documented in developed countries over the past 30 years, the authors note that these increases have occurred during a period when plasticized products have become widespread in homes, schools, and workplaces.

The Association between Asthma and Allergic Symptoms in Children and Phthalates in House Dust: A Nested Case–Control Study by Carl-Gustaf Bornehag, Jan Sundell, Charles J. Weschler, Torben Sigsgaard,5 Björn Lundgren, Mikael Hasselgren, and Linda Hägerhed-Engman in Environmental Health Perspectives, October 2004.

What are the Major Sources of Formaldehyde?

Urea-formaldehyde foam insulation: During the 1970s, many homeowners installed this insulation. Many of these homes had high levels of formaldehyde soon afterwards. The use of urea-formaldehyde foam insulation was stopped many years ago. Formaldehyde released from this product decreases rapidly after the first few months and reaches background levels in a few years.

Permanent-press fabrics, draperies, and coated paper products: In the 1960s, there were reports of allergic reactions to formaldehyde from permanent-press fabrics and coated paper products. Such reports have declined in recent years as the industry has reduced formaldehyde levels. Draperies made of formaldehyde-treated fabrics may add slightly to indoor formaldehyde levels.

Cosmetics, paints, coatings, and some wet-strength paper products: The amount of formaldehyde present in these products is small. However, persons sensitive to formaldehyde may have allergic reactions.

Pressed-wood products: Pressed-wood products, especially those containing urea-formaldehyde glues, are a source of formaldehyde. These products include particleboard used in flooring underlay, shelves, cabinets and furniture; interior grade plywood wall panels, and medium density fibreboard used in drawers, cabinets and furniture. When the surfaces and edges of these products are delaminated or uncoated they have the potential to release more formaldehyde. Manufacturers have reduced formaldehyde emissions from pressed-wood products by 80-90% from the levels of the early 1980s.

Sources of combustion: Burning wood, kerosene, cigarettes and natural gas, and operating internal combustion engines (e.g. automobiles), produce small quantities of formaldehyde. Sources of combustion add small amounts of formaldehyde to indoor air.

Carpets or gypsum board: These products do not contain significant amounts of formaldehyde when new. They may trap formaldehyde emitted from other sources and later release the formaldehyde into the indoor air when the temperature and humidity change.

Indoor Contaminants and Health

Parents striving to keep a spotless house may be triggering asthma in their children. UK and Australian researchers found that children exposed to high levels of volatile organic compounds (VOCs) were four times more likely to have asthma.

Toddlers exposed to fumes from solvents and cleaning products at home are most at risk. Polishes, room fresheners and new carpets were some of the triggers identified. Other sources of VOCs include solvents, floor adhesives, paint, and furnishings. Most appeared to be risk factors for asthma. However, the VOC levels measured were lower than recommended maximums.

Measuring total VOCs might underestimate the risks associated with individual compounds

Other studies in the UK and Australia found that newly built homes have high levels of VOCs, largely a result of emissions from carpets, floors, paints and other interior finishes. Most people would just notice a smell, but some would find it unpleasant. However, others may have headaches, and feel sick. Some homes had levels at least twice the recommended safe limit.

Measurements of indoor air quality in R-2000 homes compared to standard Canadian homes have shown the R-2000 homes to consistently have lower measured VOCs, largely due to the increased attention to the use of low emission interior finishes and continuous mechanical ventilation.

You Asked Us About:
Staggered Stud Framing on Outside Walls

There was much discussion at a recent seminar I attended about how the insulating performance of outside walls could be improved. One great idea involved the benefits associated with staggering studs on outside walls.

The discussion arose because, even though we are specifying R-20 walls on exterior walls of buildings, in fact we are providing walls with an average R-value closer to R-10, when thermal bridging at every stud is taken into account. The actual R-value at the wood stud is about R-6, while the wall cavity between the studs is filled with R-20 insulation. So, in reality the average across the whole wall is closer to R-9.

If we were to stagger the exterior wall studs on a 2x6 sill plate, the contention made is that we could greatly reduce the bridging effect at all studs and increase the effective average R-value of the wall to as much as R-18. To split the plates isn't justified because the joists below and above the stud wall still present a thermal bridge. On a 20-foot-long wall we could theoretically reduce the thermal bridging significantly even though we need to pay for additional studs, having to place more but staggered studs spaced 16" on centre.

Relative to 4" staggered studs at 12" on centre, by my calculation the $15 or so extra for materials will most likely pay for itself twice over in fuel cost savings in year one.

It is my contention that by utilizing this technique, we can essentially double the effective R-value of exterior walls providing substantial energy savings for the life cycle of any buildings we are applying this concept to.

Steel stud construction will benefit even more than wood-frame when the conductance of steel is taken into account. However, the details of doing a staggered stud wall with steel may be more arduous because of the problem of the nature of steel studs and how they are fixed to the plate.

Is there anybody that would be interested in investigating this potential?

Your concern for thermal bridging issues is correct. These are important issues and should always be dealt with. However, there are some errors in your assumptions and about the numbers that may have been discussed at the seminar.

Thermal bridging through framing does reduce the actual thermal performance. Because framing accounts for about 20-25% of the surface area of a wall, the wall's actual thermal resistance (when area-weighted-averaging takes place) is much less than the nominal R-value that is commonly used. One reason Americans refer to a 2x6 wall as R-19, rather than the R-20 terminology we use in Canada, is because this recognizes that the effective R-value in an assembly will be less than the nominal value.

Calculations show that the R-value of a typical 2x6 @ 16" stud wall with R-20 batt insulation has an effective R-value of R 16.2; if the studs are spaced @ 24" o/c, the effective R-value increases to R-17.

An effective R-value of R-10 could be attained in a 2x6 wall, but it would mean excessive framing is being used and the insulation job is abysmally poor. Both are attainable in the field if there is no scrutiny on the job site.

A more cost-effective performance upgrade can be achieved by using 2x4 framing with 1 ½" extruded polystyrene (XPS) insulation on the exterior. A 2x4 @ 16" wall with 1 ½" XPS has an effective R-value of 18.5 This kind of wall system is fairly common in residential construction in some parts of the country today. It is a much more practical and workable detail than a staggered stud wall which would require loose fill, blown-in insulation to achieve total insulation coverage without any voids. And of course, the framers and other trades would be more likely to do the job correctly.

As for steel studs, good practice requires rigid insulation on the exterior face of the studs in any case, to reduce thermal bridging. Anyone who is still building steel studs walls without rigid insulation on one side is asking for trouble.

The Appendices to the (Canadian) Model National Energy Code for Houses contains tables with the effective R-values for a wide range of construction assemblies. Ed.

You Asked Us About:
About Managing Water in the Crawl Space

I have a client who owns a 10-15 year-old-house near a lake that rises about two feet during spring runoff or other flooding periods in the fall. The house is sitting on a four-foot high crawl space. The concrete foundation wall is insulated with 2" expanded polystyrene insulation on the interior. There are two 2x6 treated wood pony walls in the middle, supporting the floor joists above. I don't know the elevation of the drain tiles, whether or not it is above or below the floor of the crawl space.

Dampness and mildew don't seem to be evident but you never know. (There is OSB applied to the underside of the joists.) There appears to be no structural problems with the treated 2x6 pony walls.

The owner wants to have a dry crawl space, but sometimes the water level rises 12" inside the crawl space as the lake floods. The water recedes when the lake level drops, but some water is retained on top of the moisture barrier on the crawl floor.

We're considering filling the crawlspace with drain rock to raise the floor, and covering it with a poly moisture barrier and concrete skim coat. The other option considered is pumping in liquified sand to raise the floor, but wrapping the wood pony wall in poly then encasing it in concrete and covering the sand with a poly moisture barrier and concrete skim coat. It is a real pain in the back to try to move that much drain rock (3,025 sq. ft.) and really expensive to pump in the sand and encase the pony walls!

Do you have any other suggestions?

It is unfortunate that people persist in building structures below the water table. The worst are cases where a full-height basement, intended to contain habitable space, is placed with the floor below the water line. Then sump pumps are installed to keep the water level low!

If the floor of the crawlspace is below the high water line, the only viable long-term solution is to raise the floor level. I would go for the drain rock approach and try to be sure that the skim coat will be above high water level. This may be a challenge to do in a confined space, but there really is no alternative. It would be a good idea to core some holes in the wall below the level of the skim coat so that any water in the area can drain out quickly as the water table drops. It would also be a good idea to investigate the possibility of replacing any wood (even if it is pressure treated) that is going to be below the skim coat level, with a concrete wall. This may also be a challenge, but well worth it for the long term. Sand fill really is not an option; although it might seem to be easier to install, it is only asking for trouble. The fine spaces between the grains of sand will actually hold water by capillarity, while the larger voids in the drain rock will allow water to drain. Ed.

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Technical Research Committee News

Canadian Home Builders' Association

Pre-delivery Inspection Protocol

CMHC has been developing a pre-delivery inspection protocol. However, this has created considerable discussion as builders have expressed concerns about being caught between the performance standard from their provincial warranty provider and the proposed CMHC document. The additional burden that would be caused by introducing another actor into the pre-delivery process was also seen as an issue. Builders have recommended that the CMHC project simply refer to the performance guidelines of the various provincial warranty programs.

A meeting between CMHC and the Canadian Home Warranty Council (CHWC) to discuss this project is planned for in the near future.

National Building Code Changes

The 2005 edition of the National Codes is scheduled for release in September 2005. This means that, depending on the regulatory procedures in various jurisdictions, the new code will come into force in early 2006.

The wording in Part 9 of the 2005 National Building Code will likely be changed with respect to porches that form part of a required exit in single detached houses. The new wording will specifically exclude such porches from higher strength requirements.

The proposed new requirement in the National Plumbing Code to regulate maximum water temperature at the tap has been deferred for further study. Ontario is the only province with such a requirement.

A new requirement in wet climate zones calls for a 10 mm capillary break in wall systems - in effect a rainscreen will now be mandatory in wet, milder climates. However, concerns have been expressed by some builders in Nova Scotia, where this requirement has already been implemented, that products used to form the drainage plain may no longer be acceptable because they are less than 10mm in thickness.

One such product is Cedar Breather, lightweight, three dimensional nylon waffle matrix underlayment for wood shingles and siding that provides a continuous air space that eliminates excess moisture from being trapped behind siding, allowing the backside to dry. It is easy to install, lightweight, and eliminates the need for furring strips. However, it is only 9 mm thick.

Solar Domestic Water Heating

Interim Certification Requirements for Solar Domestic Hot Water Systems

CSA has prepared a Technical Information Letter (TIL) that covers the technical and installation requirements for packaged solar domestic hot water systems and packaged solar domestic hot water systems for seasonal use.

TIL MSE-45 was prepared at the request of manufacturers desiring a certification program for packaged solar domestic hot water systems. It is an adaptation of the draft updates of CSA Standards F379.1 and F379.2, which are in the process of being finalized.

Building Envelope Research

Research is underway at Forintek to measure the drying capacities of various wall assemblies. It is hoped that this will provide more information on which types of systems work best. It should also provide information on how thin the capillary break must be to be effective. It may provide evidence to allow a reduction in the minimum depth of the capillary break where drainage products are used to maintain the drainage plain.

Clean up Procedures for Mould

CMHC has just released a revised version of Clean-up Procedures for Mold in Houses. This 90- page book is a comprehensive document that should be reviewed by anyone who has to deal with mould issues in houses. It includes information on assessing the problem, information on fixing the problem. It also provides background information on mould biology and key points when surveying indoor moisture and mould, preventing moisture problems, and references for other resources.

Canadian Electrical Code

The CSA Part 1 Committee adopted a new requirement for electrical receptacles in kitchen island counters that will be included in the next edition of the model Electrical Code in 2006.

The Technical Research Committee (TRC) is the industry's forum for the exchange of information on research and development in the housing sector.

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Concerns that colour-coded wiring might become a future requirement appear to be unfounded, according to sources on the Part 1 Committee. CHBA is collaborating with CSA on a paper that examines the process for considering new requirements through to their adoption into provincial regulations.

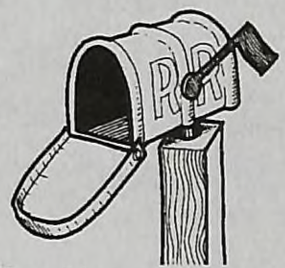
US Code To Allow Unvented Roofs

Venting attic cavities is prudent to minimize moisture damage. However, roof assemblies do not always have to be vented, as long as sound building principles are followed and construction details are carefully executed. If the ceiling can be built airtight so there is no air leakage of indoor air, then the major source of moisture into the attic is eliminated, and venting is not as critical. Although the National Building Code requires roof assemblies to be vented, in some circumstances an exception is allowed. Many building inspectors will approve the use of unvented attic construction details when there is spray foam insulation. The foam serves an air barrier function as well as insulation.

Depending on the permeability of the foam insulation, a vapour retarder may still be needed. This can be a vapour barrier paint sprayed on the foam.

A recent change to the 2006 edition of the US International Energy Conservation Code (IECC) and the International Residential Code (IRC) will allow unvented roof assemblies provided that interior vapour retarders are not installed on the ceiling side (i.e. the attic floor) of the unvented attic assembly, and that an air-impermeable insulation is applied in direct contact with the underside/interior of the structural roof deck.

There must be enough insulation installed to maintain the monthly average temperature of the condensing surface above 45°F. The condensing surface is defined as either the structural roof deck or the interior surface of an air-impermeable insulation applied in direct contact with the underside/interior of the structural roof deck. ☼



Letters to the Editor

Re: HRV Installations (Solplan Review No. 118, September 2004)

Good article on some of the common problems with HRV installations.

For more information on this topic, you could also direct your readers to the 1998 CMHC Study titled Field Survey of Heat Recovery Ventilation Systems. This study looked at 60 homes in all regions of Canada and included HRV ventilation system inspections, occupant surveys, performance testing (tracer gas testing) and some testing of experimental systems.

The study found that there were problems because of installation faults as well as a lack of homeowner understanding. Existing information transfer mechanisms need to be improved. As many of the problems observed could have been prevented by proper installation, the study suggested that installers should be required to pass the installation and designers training programs offered by the HRAI. Installers should also be encouraged to offer HRV maintenance agreements to homeowners and/or impress on them the importance of proper operation and maintenance.

A Research Highlight of the study (Technical Series 96-215) can be found on the CMHC website at: *www.cmhc-schl.gc.ca/publications/en/rh-pr/tech/96215.htm*

Jack Mantyla,
Ottawa, ON

Re: HRV Installations (Solplan Review No. 118, September 2004)

Good article. Home inspectors surveying existing housing stock generally give only cursory attention to overall design issues, given that unworkable or simply misunderstood control systems, blocked exterior air intakes and blocked or missing core filtration elements seem to be widespread.

I've noticed that ceiling supply grilles located 2-3 ft. from the doors of bedrooms and large enough for a table tennis ball are increasingly common. One often wonders whether the sleeping bodies in the room will actually experience any fresh air even after the maintenance issues have been addressed.

David Riley
Surrey, BC

NRC·CNRC

Air Barrier Materials and Systems: What is the Difference? Is There a Difference?

By Madeleine Z. Rousseau

Remember the old TV ad showing two piles of clean towels, each washed with a different detergent? We were supposed to guess what made these two piles different: The quantity or type of detergent? The fabric softener? The price? Were these piles of towels in fact different in any way?

There may be an analogy regarding the perennial questions about the characteristics of air barrier materials and air barrier systems intended to constitute the primary line of defence against air leakage across the building envelope. This article highlights commonalities and differences of air barrier materials and air barrier systems, and introduces the challenges of integrating notions of durability in the design.

Materials with Low Air Permeance

How is "low air permeance" of a material defined? Article 5.4.1.2 of the National Building Code (1995) and the assessment documentation of the Canadian Construction Materials Centre (CCMC) at NRC rate low air permeance at a maximum value of 0.02 $L/(s \times m^2)$ at a pressure differential of 75 Pa. This property can be found in several different materials. A 1988 study carried out by Air-Ins Laboratories Inc. demonstrated the low air permeance of various materials. Here are some examples: oriented strand board (11 mm and up); plywood (8 mm and up); gypsum board (12 mm); extruded polystyrene (38 mm); polyethylene sheet (0.15 mm or 6 mil); and cement board (12 mm), without mentioning materials such as metals, plastics and glass. The list of materials that did not meet this requirement included No. 15 building paper, type 1 and 2 expanded polystyrene (25 mm), asphalt-coated fibreboard (11 mm), and perforated polyethylene wrap.

Since that study in 1988, several product manufacturers have been granted CCMC evaluation reports for Air Barrier Materials, i.e., materials with air permeance equal to or lower than 0.02 $L/(s \times m^2)$ at 75 Pa.. These are:

- Tyvek HomeWrap® from DuPont Canada. Spun-bonded olefin membrane made by combining continuous fibres of high-density polyethylene into a sheet, through a process using heat and pressure. CCMC 12857-R
- Typar® II from BBA Materials Technology. Membrane of polypropylene, spun-bonded olefin fabric made from oriented polypropylene filaments thermally bonded. CCMC 12884-R
- Airmetic® 0223/Heatlok®0240 from Demilec Inc. Two-component spray urethane foam insulation. CCMC 12893R
- Isoclad® from Les produits Isolofoam inc. Type II preformed expanded polystyrene rigid insulation panel plant-laminated to a spun-bonded olefin sheathing membrane (Tyvek® grade) made by DuPont Canada. CCMC 12981R
- Styrofoam™ Weathermate Plus™ from Dow Chemical Canada Inc. Polypropylene-based, non-woven membrane. CCMC 13013R
- GreenGuard® Ultra Wrap from Pactiv Building Products. Non-perforated and non-woven polyolefin membrane made by combining an open polyethylene fabric with a polyethylene sheet. CCMC 13075R
- Walltite® /Thermal Tech® from BASF Canada Inc. Two-component spray urethane foam insulation. CCMC 12877 R
- Sto Gold Fill® from Sto Corp. Coating to spray or trowel at the joints of a low air permeance sheathing board, as part of the Sto Guard™ system. CCMC 13120R

These evaluation reports are posted on the CCMC Web site *http://irc.nrc-cnrc.gc.ca/ccmc* under Master Format Division 07273 of the Registry of Product Evaluations. Information on limitations and uses presented in the reports can be quite useful to designers and building officials. Other design criteria of an air barrier system, such as structural performance, deflection and continuity at fasteners and other junctions were not included in that type of material-only evaluation.

Air Barrier Systems

In order to ensure the airtightness of a building envelope, it is not only important to install materials with low air permeance, but most of all to integrate all these different materials and components in a continuous assembly that is designed and built to withstand the differential air pressure to which the building is subjected during its useful life (5, 10, 25, 50 or 100 years?). Wind loads exercise undoubtedly the highest pressure on walls in comparison to that imposed by the stack effect or mechanical ventilation systems.

An air barrier system (ABS) must:

- have the required structural capacity to transfer wind loads without undue deflection (this calls for rigidity or support) without altering its air permeance
- be continuous over the entire envelope
- be durable.

The system's continuity is undoubtedly the most challenging characteristic to achieve as it requires superior design, execution and quality control. The joints between the airtight elements (such as two panels), the joints between two components (such as interfaces between walls and balconies, windows, ducts and roofs), and the penetrations made in the air barrier system for fastening to other components (such as the outside cladding), are challenges stemming from the building details.

Some manufacturers developed an air barrier system for the exterior walls of low-rise buildings based on all of the above-mentioned requirements. To learn more about those evaluation criteria, consult Construction Technology Update No. 46 posted at *http://irc.nrc-cnrc.gc.ca/ctus/46.html*

CCMC lists two evaluation reports on ABS (see MasterFormat Division 07272 of the CCMC Registry of Product Evaluations:

- Walltite® - Air Barrier System from BASF Canada Inc. A system based on a urethane foam insulation to spray on the exterior face of a substrate, with accessories for continuity such as Blue Skin SA®, a modified bituminous membrane manufactured by Monsey Bakor and used as a transition membrane over construction joints. CCMC 12932R (Note the difference with Report 12877-R for air barrier material.)
- CodeBord® Air Barrier System from Owens Corning Canada Inc. An air barrier system, based on extruded polystyrene material, with accessories comprising foamed polyethylene sealing gasket and one-component spray-in-place foam sealant applied on joints. CCMC 12935R
- CCMC evaluations also include the following polyurethane foam sealants applied to several appropriate substrates to maintain the continuity of an air barrier system at penetrations such as window and door frames:
- Froth-Pak, Enerfoam, Great Stuff, Great Stuff Pro Gaps & Cracks, Great Stuff Pro 10/16/23 Pound Gaps & Cracks, Great Stuff Window and Door, Great Stuff Pro Window & Door, from The Dow Chemical Company. One-component post expanding foam or two-component polyurethane foam. The allowable air leakage rate for this foam sealant (after accelerated aging) is 0.25 m^3/h per metre of joint at 75 Pa (criteria for a fixed window). CCMC 13074R

During NRC's Building Science Insight 2003 Seminars, many industry representatives pointed out that low air permeance sheathing membranes form the basis of the air barrier system in their low-rise residential projects. At present, no air barrier system using flexible membranes has been evaluated by CCMC. The issues of maximum deflection and air leakage at fasteners and junctions as a result of wind load pressures are crucial with regard to the use of flexible membranes for air leakage control purposes.

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Table 1 Maximum Air Leakage Rate Proposed in 1986	
Indoor Relative humidity at 21°C	Permissible air leakage rate (L/s×m² at 75 Pa)
<27%	0.15
27-55%	0.10
>55%	0.05

Maximum Air Leakage Rate for Wall ABS

In 1986, IRC scientists reviewed the existing literature and applicable standards and proposed for discussion a relationship of the permissible air leakage rate for the building envelope and the indoor relative humidity level. This was based on airtightness levels specified for metal or glass curtain walls at the time, and on needs expressed about reducing the risk of interstitial condensation forming within the envelope. The higher the indoor relative humidity would be, the tighter the ABS had to be (Table 1).

Ten years later, with the advancement of numerical modelling capabilities, IRC researchers explored the hygrothermal response of virtual wall assemblies exposed to a variety of conditions. Based on such studies, they developed a relationship between the maximum air leakage rate for a wall air barrier system and the vapour permeance and the temperature of the outermost non-vented layer of the wall assembly (for indoor conditions of 36% RH) (Table 2). The lower the vapour permeance of the outermost non-vented layer of the wall, the higher the required airtightness of the air barrier system.

Table 2 Current Maximum Air Leakage Rate of Walls	
Water vapour permeance (WVP) of the outermost non-vented layer of the wall assembly (ng/Pa s×m²)	Maximum permissible air leakage rate for Wall ABS (L/s×m²) at 75 Pa
15 <WVP <60	0.05
60 <WVP <170	0.10
170 <WVP <800	0.15
>800	0.20

Requirements for maximum air leakage – and minimum risk of interstitial condensation – were more stringent in situations where the wall assembly exhibited a lower drying potential by moisture diffusion to the exterior (due to the low vapour permeance of the outmost non-vented layer).

In addition, when the temperature of this low vapour permeance element located toward the outside of exterior walls would be maintained above the dew-point temperature of the surrounding air – most of the time in winter conditions – very little condensation would be likely to accumulate on its interior face. Adding thermal insulation to the exterior face of an element of low vapour permeance resulted in an increased tolerance for a higher air leakage rate without increasing the risk of condensation accumulation within the wall. Based on its numerical modelling studies, IRC proposed a minimum ratio of outboard to inboard thermal resistance for low vapour and air permeance materials for various climate severity conditions expressed in heating degree-days (see Construction Technology Update No. 41 at *http://irc.nrc-cnrc.gc.ca/ctus/41.html*.

Durability and Location of Air Barrier Systems

The durability of a material or an assembly (let's not forget the junctions) is determined not only by the selection of properties but also by the severity of the climate to which it is subjected during its service life. If the odds of the ABS becoming exposed to rainwater loads during the construction process or during its service life are high, then its resistance to moisture attack should be higher than if it is sheltered on the inner side of the walls. For example, an ABS assembly installed in a warm dry place would be subjected to less differential movement and wetting than an ABS placed immediately behind the exterior cladding. Therefore, the climatic exposure of the ABS should be acknowledged and integrated in the decision-making process for the selection of suitable materials to be used in the ABS assembly for a given construction project.

When a sheathing membrane constitutes the principal element of a wall ABS, it is expected that the air pressure drop across this membrane would be large in relation to the total air pressure difference across the wall assembly. As this membrane also performs the function of a second layer of protection against rain penetration, it is conceivable that the wall ABS could get wet at times. Deficiencies in the installation of the ABS-sheathing membrane, e.g., tears or punctures by the cladding fasteners, could allow rainwater to infiltrate inwards where moisture-sensitive elements are located because the three conditions for water ingress would be present (i.e., a hole, a force and some water). Risks of rainwater ingress are lower when the materials exposed to the highest air pressure drops (i.e., the ABS) are kept dry. If the ABS is likely to be wetted, special measures should be taken to ensure that its continuity is not compromised during its service life.

Don't Throw In the Towel!

Going back to our introduction about the piles of towels, remember that there are important differences between air barrier materials and air barrier systems, even though they may appear to be all the same to the uninformed. Selecting a material is only a small part of the work involved in constructing and installing an effective air barrier system.

Additional Reading

- Air Barrier Systems for Walls of Low-rise Buildings: Performance and Assessment, NRCC. *http://irc.nrc-cnrc.gc.ca/catalogue/40635.html*
- The Difference between a Vapour Barrier and an Air Barrier, NRCC, *http://irc.nrc-cnrc.gc.ca/catalogue/bpn54.html*
- An Air Barrier for the Building Envelope, NRCC, *http://irc.nrc-cnrc.gc.ca/catalogue/29943.html*
- Registry of Product Evaluations, CCMC, *http://irc.nrc-cnrc.gc.ca/ccmc/home_e.shtml.* See Divisions 7272 and 7273 for air barrier systems and air barrier materials.

Environmental Building News Calls for Phaseout of Halogenated Flame Retardants

Most of us are not aware that most products we surround ourselves with are treated with flame retardants. Flame retardants play an important role in protecting us and our buildings from fire. They are used not only in consumer and office products – from electronics to furnishings but also in many building materials.

Citing an unacceptable health and environmental risk, the trade publication Environmental Building News has called for an immediate ban of one class of brominated flame retardants and a phaseout of all halogenated flame retardants unless their safety can be demonstrated.

Of most immediate concern are PBDEs, or polybrominated diphenyl ethers, a type of halogenated flame retardants that have been widely used since the late 1970s. They were introduced after the closely related polybrominated diphenyl flame retardants (PBBs) were banned in the mid-1970s following a 1973 incident in Michigan in which FlameMaster FF-1 was accidentally mixed with animal feed. That accident led to widespread contamination and health problems for thousands of Michigan residents. Like the better-known and very similar polychlorinated biphenyls (PCBs), they are stored in fat tissues and build up in the food chain.

When US production of PBBs ended in the 1970s, industry quickly switched to PBDEs and other brominated flame retardants. Today the world produces nearly 20 times as much brominated flame retardant as it did in the early 1970s when PBBs came under fire. Most brominated flame retardants today go into the hard plastic used in television and computer cases and other electronic equipment, but significant quantities are also used in polyurethane insulation, commercial drapery backings, polyester fabrics, wiring, and the soft polyurethane foam in mattresses, upholstered furniture and carpet padding. Flexible polyurethane foam can be up to 30% PBDE by weight. As the foam deteriorates over time, the flame retardants escape, contaminating the environment in which the products are found.

Health concerns about PBDEs emerged in 1999 when Swedish scientists reported that levels of these chemicals in human breast milk

had increased 60-fold between 1972 and 1997. Subsequent studies found PBDE levels in American women to be up to ten times higher than in Sweden and doubling every five years.

About 5% of the US population already has extremely high levels of PBDEs in their bodies - close to the levels at which laboratory animals develop serious health effects. Health impacts range from interference with brain development and hormone function to cancer. Europe, California and Maine have taken action to ban the two most potent forms of PBDEs, which will take effect between now and 2008.

Beyond immediate restrictions on PBDEs, Environmental Building News is calling for comprehensive testing of all flame retardants, particularly halogenated compounds (those containing chlorine and bromine). More than 150 flame retardants, including 75 brominated flame retardants, are currently on the market. Any change or substitution of flame retardants should not result in buildings becoming more dangerous.

To maintain the safety of buildings with a lesser reliance on chemicals may require a reduced use of inherently flammable materials, such as foam insulation in buildings, more reliance on the separation of flammable materials, and greater use of sprinkler systems in buildings. Simply put, we may have to change the way we build.

Information: *www.buildinggreen.com*

A Checklist for Action for Flame Retardants

Avoid combustible materials where feasible. Instead of using inherently flammable materials that have to be treated with flame retardants, such as foamed-plastic insulation, use inherently non-flammable materials, such as fibreglass or mineral wool insulation. (To avoid an energy penalty for such substitutions, thicker wall sections may be required.)

Install fire sprinklers in all occupied buildings including single-family homes to provide protection from fire.

Where feasible, avoid foam insulation in most applications unless the manufacturer can provide assurance that halogenated flame retardants are not used. Most foam insulation today is made with halogenated flame retardants, though polyisocyanurate and spray polyurethane insulation is typically made with TCPP, which contains chlorine rather than bromine and is probably less of a health and environmental risk. Rigid fibreglass, rigid mineral-wool, and all cavity-fill insulation (fibreglass, mineral wool, and cellulose) are made without halogenated flame retardants.

Do not use polyurethane foam carpet padding. Soft polyurethane foam carpet padding is produced with pentaBDE or other brominated flame retardants. As the padding disintegrates, dust may become airborne or be ingested. This dust can be particularly dangerous to infants. In place of polyurethane padding, use more traditional materials, such as jute and horse-hair padding.

June 2004 issue of Environmental Building News

CMHC Mortgage Loan Insurance Discount for Energy Efficient Homes

For information: www.cmhc.ca (search keywords are "energy refund") or call CMHC: 1-800-668-2642

CMHC mortgage loan insurance allows purchasers to buy a house with as little as five percent down. CMHC has added environmentally friendly features to the mortgage loan insurance it already offers. They are offering a 10 percent refund on the cost of the mortgage insurance for houses that are certified R-2000, or that have an EnerGuide for Houses rating of 80 or higher.

In addition, the amortization period can be extended from 25 years to a maximum of 35 years.

For purchasers of older houses, the incentive is also available. For older houses it becomes available if the Energuide for Houses rating is 80, or if upgrades are made that improve the Energuide rating by at least 5 points.

Climate Sensitive Design is Sustainable Design

Hurricanes battered the Caribbean and the southeastern US this year. A standard image on television newscasts are the folk in Florida and Georgia preparing their property for the impending storm, installing plywood over windows. One consequence is that demand for plywood and OSB shoots up and helps to keep the already high price of plywood high.

Plywood demand in the southeast may not be huge compared to the entire US market, but it is big enough to affect plywood demand throughout North America, including in Canada. Apparently major building materials suppliers stock extra inventory in anticipation of these storm events. A lot of stores have run empty as people try and board up their windows.

It may be a boon to Canadian plywood and OSB producers, as it keeps prices high. We have heard plywood prices are in the range of $400+ US per thousand square feet after averaging $160 US dollars all of last year.

However, these images do raise a few questions. What happens to all that plywood and OSB after the storms pass? Does it end up in the landfill or does it get recycled into construction and repairs? Since hurricanes are an annual occurrence, why do building designs not anticipate such events? One thinks that shutter designs could accomplish much that the plywood over windows does, but in a permanent manner. This is what is done in many other countries.

Design to suit the climate in which the building is located seems to be an art that has been forgotten because of our high standard of living and new technologies that can compensate for inappropriate design. The charm of many traditional building designs in part is accounted for by their suitability for their location. The whitewashed Mediterranean houses with small window areas are that way to reflect the hot summer heat off the buildings and reduce excessive solar gains into the house. The large roof overhangs on many tropical homes are there to keep the rain and sun out, yet capture cooling breezes.

In cold climate designs we should be looking at how we can maximize solar gains and minimize heat losses by using modest window areas, using only high performance windows and building tight, well-insulated building envelopes. We should not have to rely only on large furnaces and air conditioners to keep our homes comfortable. We should keep that in mind as we brace for the cold of winter.

We should not be questioning the extra insulation or higher efficiency furnace or water heater, rather we should see how effectively we can improve the performance of the building.

Can Masonry Support Mould Growth?

Mould grows on organic matter, and organic matter that supports mould growth can accumulate on any surface. That's why mould has even been found on glass; it's not the glass that provides the food, but the dirt on the glass.

Given today's concern about mould, it is not surprising that the masonry industry undertook tests to determine how much mould can grow on masonry products. As could be expected, the study showed that, given appropriate conditions, wood and drywall products can sustain mould growth, while clay brick and concrete products do not.

The study was done in accordance to a US military standard which is used to determine the fungal resistance of materials. It also included a condensation period of 28 days to further challenge the materials. A mixture of mould spores was sprayed onto the material samples, which were then placed in a chamber that was kept warm and humid. This was meant to be representative of conditions inside buildings in a cold climate.

At the end of 28 days the samples were examined for the presence of fungal growth. The results showed that under identical conditions conducive to the growth of fungal mould, there was no mould on the clay brick, concrete block and concrete samples, but the wood and paper products had measurable amounts of mould.

A copy of Masonry Canada's bulletin on this study and other information is available on the Masonry Canada website at *www.masonrycanada.ca*

Fungal Mould Resistance Testing (FMRT) of Common Building Materials According to MIL-STD 810E

Energy Answers

Rob Dumont

The word is starting to get out that the SRC will be involved with the development of a Factor 9 Home? What is Factor 9?

Factor 9 refers to a 9-fold decrease in the rate of pollution from the goods we produce. Why 9?

The reasoning (already discussed in the November 1998 issue of Solplan Review) goes as follows: World population is expected to increase by a factor of 1.5 before it stabilizes; the consumption level of the average person on the planet is expected to increase by a factor of 3; at the same time the climate scientists are telling us that we must reduce our greenhouse gas production by a factor of at least 2 from current levels. Multiply the three factors together and the product is 9. Since I first wrote the article in 1998, world population growth estimates have come down somewhat – an encouraging trend for the planet.

The Factor 9 Home, to be built in Regina in 2005, will be designed to use only one-ninth as much energy as a conventional Regina home. The house should consume only about 30 kilowatt-hours per square metre per year of total purchased energy (9500 BTU/square foot per year) in a climate with 5750 annual heating degree day Celsius.

Why do you call it Factor 9 and not Factor 10?

One big reason is that there already is a house with the name Factor 10 that was built in Chicago recently.

Who is sponsoring the Factor 9 Home?

A new federal-provincial agency, the Regina-based Communities of Tomorrow, is a major sponsor along with the Saskatchewan Office of Energy Conservation and the Saskatchewan Research Council. The City of Regina and the University of Regina are helping out with the design and monitoring. The Regina Home Builders' Association has been a key resource with the builder selection process. We are also seeking out additional sponsors.

What will the Factor 9 Home look like?

At this stage, we do not have the design in place. However, there is a rich legacy of past energy-efficient demonstration homes in Canada on which to build. The Saskatchewan Conservation House –1978; the Brampton Advanced House–1990; the Canadian Advanced Houses—1992-93, and the Toronto Healthy House–1994 are some of the better known demonstration houses.

In all of these past demonstration projects, two main approaches were incorporated: First, the homes used high levels of energy conservation compared with conventional homes; second, the homes made use of renewable energy via both passive and active solar energy approaches.

The Factor 9 Home will use both these approaches as well.

What are some improvements that you hope to incorporate compared with past demonstration projects?

Here are some technologies that look promising at this stage:

1. Better performing window glass. Better low e coatings, improved gas fills are now on the market.

2. Use of larger south-facing window areas along with increased thermal mass to increase the passive solar contribution without causing overheating. A comprehensive look at the optimum combination of window type, window area, thermal mass, and overhang geometry for the south windows has already begun.

3. Better electrical appliances. Energy Star will be the minimum performance standard for appliances such as the refrigerator, freezer, clothes washer, and dishwasher.

4. Heat recovery on the domestic hot waste water.

There are now some commercially available, low maintenance devices that can be used to reduce the domestic hot water load.

5. Improved performance heat recovery ventilator. Conventional HRVs use a substantial amount of electrical energy – one European company produces a unit that uses only 20 watts of electricity vs. about 50 for the best North American unit.

6. Better commissioning. On several past projects, including on my own house, the commissioning has been spotty. The typical house built these days has less instrumentation than a stationary exercise bicycle. A careful look will be made at better instrumentation to diagnose operating faults with key equipment. To cite one example, most active solar heating systems can suffer back thermosyphoning from the storage tank to the outdoor collector panels at night and on cloudy days if the check valve on the glycol loop is not working.

7. Use of very inexpensive instrumentation that can readily identify operational problems with equipment. Simple remote reading temperature sensors are invaluable for diagnosing many faults with heating and hot water systems.

Why not go for a Zero Energy Home?

At this stage in the technology development, the incremental cost to go to Zero Energy is just too high for the limited budget available for this project.

Fortunately, you can now purchase wind-generated certified Green Power in Saskatchewan from our utilities. That last bit of energy needed for the house could be supplied by that type of Green Power. (The electric utility recently announced that it would be installing 150 megawatts of new wind generation equipment in the southwest part of the province.) ☼

Comparison of Under-Floor Insulation Systems

Comparison of Under-Floor Insulation Systems *by Enermodal Engineering for CMHC Research Division*

The importance of properly insulating concrete floor slabs is now well recognized. This becomes more important as a greater use is made of basements as living spaces and more radiant heating systems are being installed.

Insulation of floor slabs requires robust materials and must be done early in the construction process before the concrete is poured.

As more slab-on-grade insulation is being used, new basement slab insulation products are being marketed. An aggressive marketing campaign by manufacturers of foil-faced bubble pack insulation is enticing some builders to use bubble pack as under slab insulation. Another insulation supplier is promoting the use of the window cutout panels from steel-skin doors as under-slab insulation. These 44-mm thick polyurethane panels have the steel door skins on each side. Many builders stick with the traditional extruded polystyrene (XPS) panels.

As the number of products available to consumers increases so does the confusion about their performance. Unfortunately, not all products have had their thermal performance independently verified. The claims made by marketers of bubble pack are especially misleading. That is why a CMHC study set out to measure the performance of three basement slab insulation products in the field. Each product was analysed during the heating season for its thermal performance.

In one house, the basement floor was insulated with a double-layer bubble pack with an intermediate foil layer; in the second house with steel-skinned 44-mm polyurethane panels; and in the third with 50-mm thick extruded polystyrene. A fourth house was the control and had no under-slab insulation. All four basement slabs were instrumented and monitored. Data was gathered from February 2004 to June 2004.

The R-values for all three insulating materials were assumed to be unknown and were calculated from the monitored data. (Table 1). The values are for in-situ performance and therefore include all modes of heat transfer.

Results from the control (uninsulated) house showed there was little temperature difference

Table 1: R-value of insulation materials

Insulation	Thermal resistance
44-mm, steel-skinned polyurethane	14.6 *(RSI 2.56)*
50 mm extruded polystyrene	12.17 *(RSI 2.13)*
Bubble pack	2.28 *(RSI 0.4)*

Table 2. R value comparison of extruded polystyrene

Insulation	Thermal resistance
Calculated in-situ	12.17 *(RSI 2.13)*
Canadian Construction Materials Center (NRC)*	10.62 *(RSI 1.86)*
ASHRAE*	10.05 *(RSI 1.6)*

** Note: both of these values are for long-term, aged materiaThe in-situ tested value is for new material.*

Figure 2: Temperature profile for bubble pack

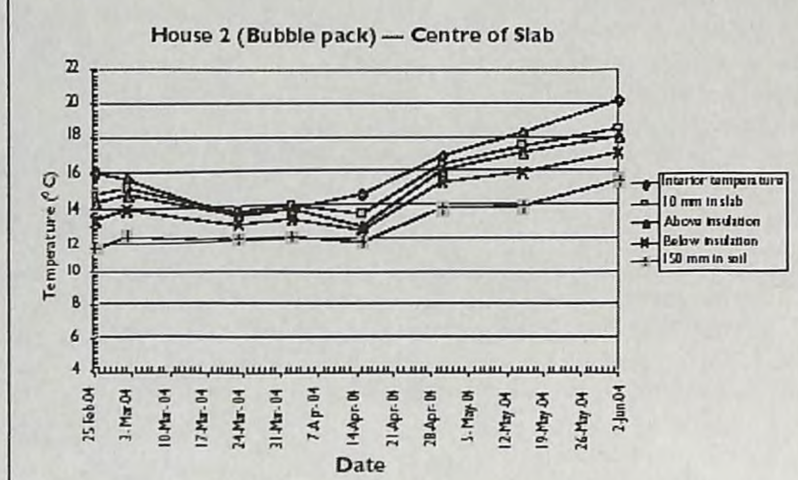
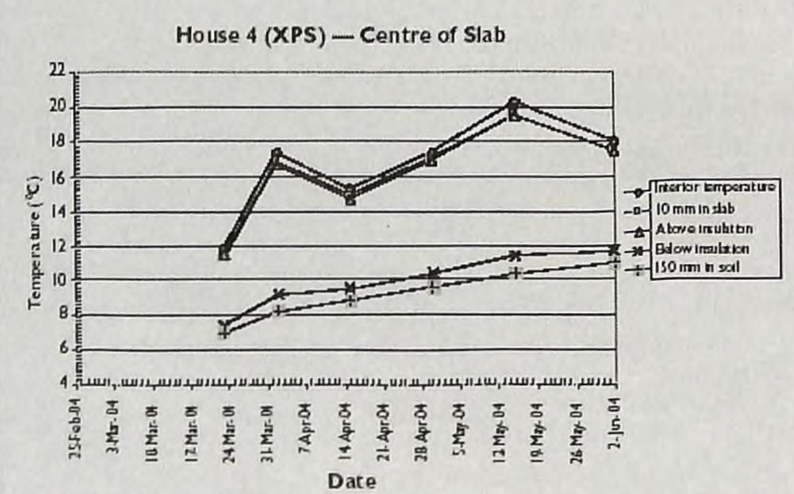


Figure 4: Temperature profile for polyurethane



The top two lines show the temperature profile indoors and in the top 10 mm of the slab. The lower lines are below the insulation and 150 mm into the ground.

between the inside of the basement and the ground below. The ground temperature varied with indoor temperature, and the ground under the insulation was warmer than expected for undisturbed, deep-ground temperatures. In other words, the house was helping to keep the ground warm.

The performance of the bubble-pack insulation was very similar to that of an uninsulated floor.

The extruded polystyrene insulation performed as a well-insulated floor slab would be expected to perform. There was a big temperature difference between the inside of the basement and the ground below. The ground temperature appeared to be influenced much more by ambient ground conditions than by any indoor temperature fluctuations. The ground temperatures were closer to expected undisturbed ground temperatures as determined using ASHRAE ground temperature data.

The steel-skinned polyurethane panels performed similarly to 50 mm of XPS.

As an indicator of the accuracy of the test, the calculated thermal resistance of the installed XPS was compared to published data. (Table 2)

Conclusion

The bubble-pack insulation had a low insulating value compared to the polyurethane panels and the XPS board. The cost-benefit was the poorest of all insulting materials tested.

The 50 mm extruded polystyrene insulation had an R-value similar to published data for the material. A cost-benefit analysis suggests it is a better option than the bubble-pack insulation in terms of $/m² R.

The steel-skinned polyurethane had an R-value slightly better than the XPS and a much lower material cost. It was found to have the best cost-benefit value of the materials tested. ☼

Polybutylene Pipe Class Action Resolved

A settlement has been reached in a class action lawsuit against the manufacturers of polybutylene piping. The final settlement was approved by courts in British Columbia, Ontario and Quebec and notice was published on June 11th, 2004.

The settlement applies to polybutylene (poly-B) plumbing systems, service lines, and hot water heating systems installed between January 1, 1978, and December 31, 2002, where there have been failures or leaks. Manufacturers listed in the court case are Shell, Dupont, and Celanese.

Compensation amounts payable to qualifying owners varies depending on the type of plumbing and the extent of damage, but can be as much as $7,000 where a complete replacement of the polybutylene plumbing has had to be done.

A qualifying poly-B related failure is defined in the settlement as a hot water heating system with either a leak in the polybutylene pipe or fittings, or the repair or replacement of any ferrous parts (iron or steel) in the poly-B hot water heating system including the boiler, heat exchanger, expansion tank, and circulator due to corrosion. A poly-B related failure does not include any maintenance of the poly-B hot water system as recommended by the system designer or the components manufacturer, or any repairs undertaken to upgrade the poly-B water heating system.

More information about the case and details for making claims can be obtained by checking the cases's Web site at: www.polypipes.ca or the site of one of the legal offices at *www.poynerbaxter.com*

To make a claim for compensation under the Shell polybutylene settlement agreement, call the toll-free phone number 1-866-348-0333.